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Geohelminthic: human ascariasis and trichuriasis in Mazandaran province, northern Iran

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Abstract

Background: Ascariasis and trichuriasis are the most common intestinal geohelminthic diseases, and as such they are significant in terms of clinical and public health. This study was done to determine prevalence, status and geographic distribution patterns for Ascariasis and Trichuriasis. The study was done in the period 1991-2014 in northern Iran using Aregis 9.2 software.

Methods: This was a review study, using description and analysis, of geographical distribution of *Ascaris* and *Trichuris* relating to townships in Mazandran province, northern Iran, covering a 23-year period. Data were collected from a review of the relevant literature, summarized and classified using Arc GIS, 9.2 to design maps and tables.

Results: Based on results presented in tables and maps, means for prevalence of *Ascaris* and *Trichuris* were divided into five groups. The maximum prevalence rate of *Ascaris* was 16.3% reported in rural areas of Tonkabon in 1981-1982. Prevalence means for *Ascaris* in the central and western areas of Mazandaran province were 2%-4% and 4%, respectively. The maximum prevalence of *Trichuris* in the rural area of Tonkabon was 22.5% and the lowest 0.06% was among the cattle breeder's in rural areas of the province at in 2002-2003.

Conclusion: Data presented in this study provides information useful to health care workers researchers and health administrators, especially for physicians, clinicians and for future research. Also, it is necessary to control and prevent geohelminthic parasitic infections, particularly in rural areas by public education for families, health authorities and health care systems.

Keywords: Geohelminths, Ascariasis, Trichuriasis, Geographical distribution

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Introduction

Intestinal helminths parasitic infections are closely related to personal, public health and environmental conditions, especially *Ascaris* and *Trichuris.* These soil transmitted helminths, transmitted by fecal contamination of soil, foodstuff and water supplies, are considered as a health concern in Iran and in developing countries (1-5). Among the parasitic infections, the soil-transmitted helminthes (STH) are a common group of intestinal parasites that cause human infections through contact with parasite eggs or larvae (in warm and moist soil), particularly attributed to the class of the nematoda, such as *Ascaris lumbricoides*, *Trichuris trichiura* and the hookworms (*Ancylostoma duodenale* and *Necator americanus*) (1,4,5). Approximately 1 billion people worldwide are affected by soil-transmitted infections and school children are the most heavily affected group. Estimates determine that over one billion people are infected with *Ascaris lumbricoides*, 800 million with hookworm and 770 million with *Trichuris trichiura* (2). Geohelminths is the second most common cause of mortality in children under 6 years of age in Africa (3). *Ascaris Lumbricoides* and *Trichuris trichiura* are among the most common STH helminthes and as such they constitute a major concern for public health, particularly in countries with low and middle-incomes population (1,6,7). They cause infection in about one quarter of world's population (1,5). Helminths worms are a major health concern, particularly for children worldwide; in both developing and under developed countries, tropical, semitropical and temperate regions, as well as areas affected by poverty with poor sanitary and hygiene conditions and waste disposal facilities. Parasitic infections are also prevalent among emigrants and asylum seekers in developed countries (8). Higher rates of these infections have

been reported in people with compromised immunity and malnutrition (9). These soil-transmitted nematodes are a major health concern worldwide. Infected patients develop nutrition and intestinal problems, as well as other complications contributing to high rates of hospital admissions and cases of surgery as a result of *Ascaris lumbricoides,* annually (10-14).

According to the World Health Organization (WHO) survey, more than 60 000 people die of *Ascariasis* complications per year (7,15). In addition, annual hospital costs to treat re-infected patients are high because infections can remain untreated. This impaired chain could continue over a long period (15-17). *Ascariasis* has been one of the most common helminths infections in Iran (18). Various factors could have an effect on prevalence of the disease, such as use of human biofertilizer, unhygienic human waste disposal, suitable environmental conditions (moisture, temperature, and shade and clay soil), human exposure to environmental contamination from sources, such as water, vegetables or soil. The trichuriasis mode of transmission is similar to ascariasis and parasite infections are more prevalent in rainy and tropical regions and resistance of parasite eggs against cold is higher than that in *Ascaris* (5,18).

Reports show higher prevalence of geohelminths infection in rural areas compared to urban. Studies in Hamedan province (Iran) up to the year 1997, indicate a high rate of ascariasis prevalence. In some rural areas of Hamedan province, this infection has reached a rate of more than 70% (19). The rate of ascariasis in the Caspian Sea coastal area was reported 14%-60% (18,20). Rokni (18) in a review of the related literature showed prevalence of ascariasis 0.01%-0.03% in Iran (18). In past decades, the highest rate of trichuriasis was reported 78.3% in coastal areas of the Caspian Sea (20). However, in the Iranian cities of Rasht and Anzali, rates were reported 1.5% and 3.1%, respectively (21). Ashrafi (21) showed prevalence of this worm in rural areas of Anzali, northern Iran 0.3%.

Studying the geographic distribution of parasite infection based on area, year and prevalence of infection provides useful knowledge on the status of diseases in a particular environment, and provides indications for status among individuals, families and public hygiene. Furthermore, there is the possibility of contaminated soil and vegetables caused by the use of wastewater, feces and well water in irrigated food production, humans are exposed to contamination by a lack politeness around fields. Mazandran province in Iran has climatic conditions that support the transmission of parasites (21). Conditions such as heavy rainfall and high humidity provide suitable conditions for parasites (22). Thus, ascariasis and trichuriasis are the most common intestinal geohelminths diseases with clinical and public health significance. Mazandran province is a tourist destination. Therefore, study of ascariasis and trichuriasis distribution as the main soil-transmitted intestinal parasites in different regions of this province has been considered as a main health concern in recent decades. Hence, present study was done to determine prevalence, status and geographic distribution patterns of ascariasis and trichuriasis using the Aregis 9.2 Software, in Mazandaran province, northern Iran in 1991-2014.

Methods

In this review study, a description and analysis of the geographical distribution of *Ascaris* and *Trichuris* prevalence were made. The study was based on a township in Mazandran province, northern Iran covering a 23-year period (Figure 1). Data were collected from 1991 to 2014 through electronic databases, such as PubMed, Google Scholar, Science Direct, Scopus, Web of Science, Magiran, Irandoc and Iran Medex, Scientific Information Database (SID), Global Health, and LILACS. Abstracts from scientific congresses and dissertations were also included in the study. The data were summarized and classified. Using the software Arc GIS 9.2, a map was designed to show geographical distributions of disease prevalence (23-25).

Table arrangement

Two tables were prepared showing classification of data collected from the relevant literatures. The tables present data according places of distribution, year of the report, percentage of infection, title of papers, and authors. Collected information were reported from various studies related to Mazandran province from 1991 to 2014.

Map preparation

Referring to the tables and the map of Mazandaran province, Arc Gis 9.2 software was used to prepare a database. Maps showing data for the two helminths diseases were drawn from information based on means of prevalence and geographic distribution reported from different areas of the province (15 townships and 38 districts) over a 22-year period.

Results

According to the study design, the prevalence, status and pattern of geographic distribution of ascariasis and trichuriasis parasitic diseases in humans were determined and described in Mazandaran province in the study period. This research contributes to databases for etiologic agency, distribution area and year of publication; percentages of infections were prepared and these shown in Tables 1 and 2. Based on these tables, disease in Mazandaran province was shown in terms of prevalence of infection and distribution area for each parasite, using the Arc Gis 9.2 software. The highest rate of infection of ascariasis was 16.3%, shown in the rural area of Tonecabon township in 1991-1992 and the lowest, was 0.12% observed in patients with gastroenteritis referring to health centers in the townships of Babol and Babolsar in 2005-2006 (Table 1). Due to the prevalence of ascariasis and its means per year, a map of disease distribution was prepared, considering the township in Mazandaran province (Figure 2). Plotting distribution of ascariasis on a map was designed according to the following 5 groups:

First group: Ramsar (western region), Savadkooh (central

Table 1. Distribution status of ascariasis, based on the distribution area, year of publication, percentage of infection reported from various study in Mazandaran province, Iran, 1991 to 2013

Distribution place or report	Year of publication	Infection rate %	Title of the paper	Author
Inhabitants from 27 rural areas of Tonekabon from the hill stations and flat areas	1991-1992	16.3%	Prevalence of intestinal parasites in the rural areas of Tonekabon, Iran.	Rezaeian et al (20)
The rural areas of the Noor and Behshahr Township	1995	2.4% Behshahr; 2.3% Noor	Study on the frequency of intestinal helminth from the rural areas of behshahr and Noor Township of Mazandran province	Saboori et al (22)
The rural areas of Amol township	1998-1999	3.1%	Study on the frequency of intestinal parasite from the rural areas of Amol township	Hashemzadeh Omran and Mobedi (23)
The flat and forest areas of 28 rural areas of Sari township	1998-1999	Total 0.4%; Farmer 0.61%; Housewife 0.85%; Student 0.35%	Prevalence of intestinal parasites in the rural areas of Sari county	Rohani et al (26)
All of the elementary students at the East Bandpay areas of Babol township	1999	0.1%	Contamination of intestinal parasites in primary school in the Bandpey area, eastern region Babol 1999.	Ghahremanlo et al (27)
East health center of Babol Narivaran Shohada	2000	4%	Frequency of intestinal parasitic contamination in Babolian schools girls, 1998.	Sajjadi et al (37)
East Mazandran	2000	1.5%	The prevalence of parasite infection in eastern areas of Mazandaran.	Abedian and Parsaei (39)
Qaemshahr township	2002	The individual infected with parasite 0.3%	Relationship between serum IgE and intestinal parasites.	Jalalian et al (29)
Cattle breeders at rural areas of 9 township in Mazandran province	2002-2003	Total 0.4%; Cattle breeders infected with parasite 25%	Intestinal parasitic protozoan and helminthic infections in cattle breeders in rural regions of Mazandaran province in 2003.	Gholami et al (4)
The gastroenteritis patients referring to the 7 health care centers of the Babol and Babolsar township	2005-2006	0.12%	Frequency of cryptosporidiosis, isosporiasis and other enteropathogenic parasites in gastroenteritic patients (Babol and Babolsar; 2005-2006).	Ghorbannia Delavar et al (38)

Table 2. The trichuriasis distribution status based on the distribution place, the year of report, percentage of infection reported from various studies in Mazandaran province from 1991 to 2013

Distribution place or report	Year of publication	Infection rate %	Title of paper	Author
Inhabitants of 27 rural areas of Tonekabon from the hill stations and flat regions	1991-1992	22.5%	Prevalence of Intestinal Parasites in the rural areas of Tonekabon, Iran.	Rezaeian and Hoshiar (20)
The rural areas of Amol township	1998-1999	6.6%	Study on the frequency of intestinal parasite from the rural areas of Amol township	Hashemzadeh Omran and Mobedi (23)
The mental retarded primary school children of Babol city	1999	3.3%	Prevalence of intestinal parasitic infections in primary school children with the exceptional mental of Babel county.	Gholampour (28)
All of the primary school students in the east Bandpay	1999	0.5%	Contamination of intestinal parasites in primary school in the Bandpey area, eastern region Babol 1999.	Ghahremanlo et al (27)
East health center of Babol Narivaran Shohada	2000	1%	Frequency of intestinal parasitic contamination in Babolian schools girls, 1998.	Sajjadi et al., 2000 (37)
East Mazandaran	2000	0.5%	The prevalence of parasite infection in eastern areas of Mazandaran.	Abedian and Parsaei (39)
Qaemshahr township	2002	0.3%	Relationship between serum IgE and intestinal parasites.	Jalalian et al (29)
Cattle breeders at rural areas of 9 Township in Mazandaran province	2002-2003	0.06%	Intestinal parasitic protozoan and helminthic infections in cattle breeders in rural regions of Mazandaran province in 2003.	Gholami et al (4)
The cities and the rural areas of Qaemshahr city	2004	1%	Prevalence of Intestinal Parasites in Ghaemshahr in 2004.	Ranjbar Bahadori et al (31)

region) and Mayandorod (eastern region) with no reports of parasitic infection.
Second group: Sari and Qaemshahr (central region); with mean prevalence of ascaraisis less than 1%.
Third group: Galogah, Behshahr, and Nekah in the east and Babol in the central region of Mazandran province; townships with mean prevalence of ascariasis 1%-2% (26,27).
Fourth group: Townships of Amol and Noor (central region of the province) with mean prevalence of 2%-4%.
Fifth group: The township of Tonekabon with mean prevalence of 4% in the western area of the province (Figure 2).
Results of this study indicate prevalence of trichuriasis 22.5% in the rural areas of Tokenkabon in western of Mazandaran province in 1991-1992 and 0.06% in cattle breeders of the 9 townships in the province in 2002-2003 (Table 2). Gholampour (28) reported prevalence of *Trichuris trichiura* in infection the mentally retarded elementary school students of Babol township 3.3% (Table 2). That figure does not agree with the rate of 0.5% in the same year recorded in the primary school students in the Bandpey area, eastern region of Babol (Table 2). Data as described by the map, indicate the mean of infection prevalence rate of *Trichuris trichiura* more than 5% in Amol and Tonekabon (western areas), 1%-2% in Babol and lower than 1% in the townships of Noor, Qaemshahr (central area), Sari, Nekah, Behshahr and Galogah (eastern area) in Mazandaran province (Figure 3).

Discussion

Ascariasis and trichuriasis are two important intestinal geohelminthic diseases with clinical and public health significance (1,5,7). In recent years, medical sciences researchers, in order to extend knowledge on distribution of infectious diseases for planning and implementing effective treatment measures, have used geographic information system (GIS) and the occurrence of disease in a particular past period to monitor the disease and health conditions. Some researchers, using GIS and plotting distribution of a disease on a map have investigated *Fascioliasis* in northern Iran and presented a map of the *Visceral leishmaniasis* disease, indicating the high risk regions in Ardabil province in 1999 (24,25). This review study was done to determine prevalence, status and pattern of geographical distribution of *Ascaris* and *Trichuris* in Mazandaran province, northern Iran in1991-2014.
The areas have suitable environmental conditions in terms of climate, humidity and water temperature to facilitate the transfer of parasite eggs and larvae to humans. However, a review of the relevant literatures highlighted a reduced rate of infection from intestinal helminths in Mazandaran province with a few exceptions, in particular cases of ascariasis and trichuriasis, as STH. Though, ascariasis had an apparent decline in incidence rate from 16.3% to 0.1% from 1981 through 1999 (20,23,26-28), but the following years showed a decline of helminthic infection (24,29-31). The latest report on prevalence of gastroenteritis patients referring to the Babol health center indicated 0.12% in 2009-2010 (32).
In Mazandaran province, limited studies have been done in different social groups; the obtained data indicated a partial decline in the rate of *Ascaris* prevalence in cities after 2000. *Trichuris* occurrence showed a significant reduction in 2005 compared to 2001 (from 22.5% to 0.3% in Tonekabon and to 0.9% in Behshahr and Noor (22,28,30). Prevalence rates of 6.6% and 3.3% were reported in Amol and special students in Babol, respectively (27,28,32). However, in the same year, a prevalence rate of 0.5% was reported in elementary school students in the east Bandpay region of Babol and there was a similar rate in the following year (27). The latest infection rate in Qaemshahr was reported 0.8% in 2004 (31). The maps showed higher rates of helminthic infection in Tonekabon, Amol and Babol. One limited study on mentally retarded elementary school students showed trichuriasis 3.3% (28), but no study has been done to date on infection rates of *Ascaris* and *Trichuris* in different age groups, particularly among children in contact with soil.
In the current study, infection distribution maps of *Ascaris* and *Trichuris* have shown prevalence of 2 parasitic diseases reported sporadically in the rural population in different years and areas. However, an epidemiologic study using the system of geographical informatics needs to be done in order to evaluate the conditions of diseases and

Figure 1. The Mazandran province map based on the townships and their location.

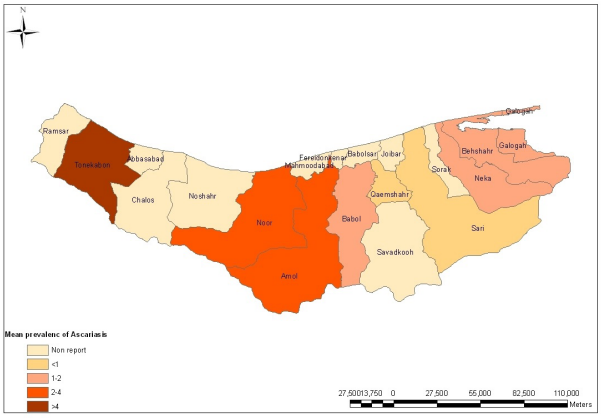

Figure 2. The geographical distribution of the mean prevalence rate of *Ascariasis* in the Mazandran province, from 1991 to 2013.

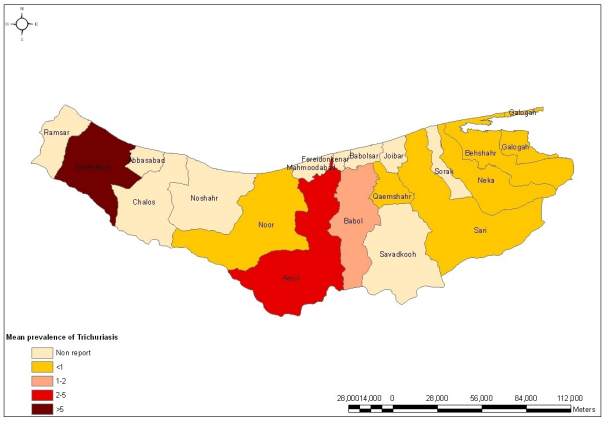

Figure 3. The geographical distribution of the mean prevalence rate of *Trichuriasis* in the Mazandran province, from 1991 to 2013.

distribution patterns in Mazandaran province (northern Iran). However, a study that to cover both urban and rural distribution status of *Ascaris* and *Trichuris* is needed, particularly in high risk areas. *Ascaris* and *Trichuris* are STH, so incidence increases with increased consumption of raw materials from the soil, such as root of vegetables. With the current increasing trend of organic fertilizer application, parasites should be identified in soil and drinking water, rather than among people with direct and indirect contact with water and/or soil. The severity of geohelminths disease particular attention because of its widespread geographic distribution (33); deleterious effects on nutrition and immune disorder (34,35). Therefore, authorities should be more attentive to the field of education and the control of food-borne helminthes and protozoan parasitic diseases in various parts of Iran (30,36).

The map in this study showed higher mean rate of *Ascaris* infection in Tonekabon (western Mazandaran), Amol and Noor (central area), Nekah and Behshahr (eastern area). A comparative study on distribution of rate of ascariasis and trichuriasis were conducted more in Amol (central area) and Tonekabon (western area) showed distribution of these 2 parasites in flat and forest areas of Mazandaran from 1991 to 2014. Although conditions of general hygiene have significantly improved in recent years particularly in relation to food stuff and the quality of drinking water, has also improved in the provincial townships. Townships of Ramsar, Chalos, Savadkoh, Joybar, Mahmood Abad, Babolsar and Galogah were not included in this investigation (Figures 1 and 2) (37-39). Thus, it is recommended for future studies in order to obtain correct patterns of disease distribution.

Conclusion

Data presented in this study provide useful information for health care workers, especially physicians and clinicians, researchers, health centers and health administrators. Results of this study demonstrate prevalence and geographical distribution of *Ascaris* and *Trichuris* and their relation to public health in northern Iran. This study emphasizes the need to establish rates of incidence, prevalence, disease burden and distribution of helminthes and protozoan infection in many parts of the Iran as well as in the wider Middle Eastern region, so that, regional, national and global estimates can be made. Therefore, it is necessary to control and to prevent the most common parasitic infections, particularly in the townships in the rural areas of the province with higher rates of prevalence. Hence, public education is necessary for families, and health care systems.

Ethical issues

This study was approved by the Deputy of Research Affairs of Mazandran University of Medical Sciences, coded 91-109, in cooperation with the Cell and Molecular Biology Research Center, the Geographic Informatics System Research Center and the Department of Parasitology and Mycology, Mazandran University of Medical Sciences and the department of Health and Infection Control of the University. It is declared that all data collected during the study are presented in this manuscript and no data from the study has been, or will be published separately.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

The study designed by SG and all authors contributed equally to the data acquisition, analysis and interpretation. All authors also critically reviewed, refined and approved the manuscript.

References

1. Ojha SC, Jaide C, Jinawath N, Rotjanapan P, Baral P. Geohelminths: public health significance. J Infect Dev Ctries 2014; 8(1): 5-16.
2. Ogbe MG, Edet EE, Isichel MN. Intestinal helminth infection in primary School Children in areas of operation of shell petroleum development company of Nigeria (SPDC) western division in delta state. Nig J Parasitiol 2002; 23(1): 3-10.
3. Nock IH, Duniya D, Galadima M. Geohelminth eggs in the soil and stool of pupils of some primary schools in Samaru, Zaria Nigeria. Nig J Parasitiol 2003; 24(1): 115-122.
4. Gholami S, Sharif M, Mobedi E, Ziaei H, Ali Mohammadpour R, Kianiyan H. Intestinal parasitic protozoan and helminthic infections in cattle breeders in rural regions of Mazandaran province in 2003. Proceedings of the Fourth National Congress of Occupational Health; 2004; Hamadan Univ Med Sci; 519-529. [In Persian].
5. Yap P, Fürst T, Müller I, Kriemler S, Utzinger J, Steinmann P. Determining soil-transmitted helminth infection status and physical fitness of school-aged children. J Vis Exp 2012; (66): e3966.
6. Hotez PJ, Fenwick A, Savioli L, Molyneux DH. Rescuing the bottom billion through control of neglected tropical diseases. Lancet 2009; 373(9674): 1570-5.
7. WHO. Soil-transmitted helminth infections. http://www.who.int/mediacentre/factsheets/fs366/en/. Accessed May l, 2015.
8. Chan MS, Medley GF, Jamison D, Bundy DA. The evaluation of potential global morbidity attributable to intestinal

nematode infections. Parasitology 1994; 109(Pt 3): 373-87.
9. Lili Z, Bingxiang Z, Hong T, Shuhua X, Hotez P, Bing Z, et al. Epidemiology of human geohelminth infections (ascariasis, trichuriasis and necatoriasis) in Lushui and Puer Counties, Yunnan Province, China. Southeast Asian J Trop Med Public Health 2000; 31(3): 448-53.
10. Ramareddy RS, Alladi A, Siddapa OS, Deepti V, Akthar T, Mamata B. Surgical complications of Ascaris lumbricoides in children. J Indian Assoc Pediatr Surg 2012; 17(3): 116-9.
11. Mukhopadhyay M. Biliary ascariasis in the Indian subcontinent: A study of 42 cases. Saudi J Gastroenterol 2009; 15(2): 121-4.
12. Esposito C, Settimi A, De Marco M, De Fazio C, Giurin I, Savanelli A, et al. Surgical complications of ascariasis in children. J Pediatric Surg Spec 2008; 2(3): 8-12.
13. Refeidi A. Live Ascaris lumbricoides in the peritoneal cavity. Ann Saudi Med 2007; 27(2): 118-21.
14. Sanai FM, Al-Karawi MA. Biliary ascariasis: report of a complicated case and literature review. Saudi J Gastroenterol 2007; 13(1): 25-32.
15. WHO. Prevention and control of schistosomiasis and soil-transmitted helminthiasis. Geneva: WHO; 2002.
16. Hwang SW. Mortality among men using homeless shelters in Toronto, Ontario. JAMA 2000; 283(16): 2152-7.
17. Cheung AM, Hwang SW. Risk of death among homeless women: a cohort study and review of the literature. CMAJ 2004; 170(8): 1243-7.
18. Rokni MB. The present status of human helminthic diseases in Iran. Ann Trop Med Parasitol 2008; 102(4): 283-95.
19. Fallah M, Azimian MH, Nabiee M, Hojati M. Epidemiological study of Ascariasis in Hamadan city, west of Iran, 2001. Journal of Hamadan University of Medical Sciences 2004; 11(1): 55-60. [In Persian].
20. Rezaiian M, Hooshyar H. Prevalence of Intestinal parasitic infection in rural areas of Tonekabon, Iran. Iranian Journal of Public Health 1996; 25(3-4): 47-58. [In Persian].
21. Ashrafi K. Medical Helminthology. Ist ed. Rasht: Payame Sobhan; 2009. [In Persian].
22. Saboori A, Masood J, Mobedi E, Rezaeian M. Prevalence of intestinal parasites in the Behshahr and Noor cities [Thesis]. Tehran: Tehran University and Medical Sciences; 1995. [In Persian].
23. Hashemzadeh Omran A, Mobedi E. Evaluation of intestinal parasites prevalence in the rural areas of Amol county [Thesis] Tehran: Tehran University and Medical Sciences; 1998-1999. [In Persian].
24. Salahi Moghaddam A. Epidemiology of human Fascioliasis in Iran. J Kerman Univ Med Sci 2009; 16(4): 385-98 [In Persian].
25. Sayahi F, Hossini M, Ziaei H, Gholami S. Geographical distribution of enteobiasis in Mazandaran province, 1981-2013. J Mazandaran Univ Med Sci 2015; 24 (121): 481-9 [In Persian].
26. Rohani S, Kianiyan H, Athari A. Prevalence of intestinal parasities in villages of Sari (1998-99). J Zanjan Univ Med Sci 2001; 9(34): 33-40. [In Persian].
27. Ghahramanloo M, Hassanjani Roshan MR , Haji Ahmadi M. Prevalence of intestinal parasites in primary school children, Eastern Bandpay, Babol, 1999. J Babol Univ Med Sci 2001; 3(2): 47-51. [In Persian].
28. Gholampour A. Prevalence of intestinal parasitic infections in primary school children with the exceptional mental of Babol county. Islamic Azad Univ Sci 1999; 3(5): 158. [In Persian].
29. Jalalian M, Rezaiian M, Kia EB, Massoud J, Mahdavi M, Rokni MB. Relationship between serum IgE and intestinal parasites. Iran J Publ Health 2004; 33(1): 18-21.
30. Gholami SH, Mohammadpour Tahamtan RA, Sharif M, Ziaei H, Euroji A,GohardehI SH, et al. Intestinal parasite infections in cattle breeders in rural regions of Babol town during 2003. J Babol Univ Med Sci 2005; 7(4): 83-7. [In Persian].
31. Ranjbar Bahadori S, Dastorian A, Heidari B. Prevalence of intestinal parasites in Ghaemshahr in 2004. J Medical Sciences 2005 2004; 15(3): 151-5. [In Persian].
32. Rahimi-Esboei B, Gholami S, Ghorbani Pasha Kolaei A, Pour Haji Baqer M, Hasannia H, Shaban R, et al. The Prevalence of Intestinal Parasitic Infections among the People Living in the Central Areas of Mazandaran Province (2009-2010). Medical Laboratory Journal 2013; 7(2): 43-8 [In Persian].
33. WHO. Prevention and control of intestinal parasitic infections. Geneva: WHO; 1987.
34. Allen LH. Nutritional influences on linear growth: a general review. Eur J Clin Nutr 1994; 48 Suppl 1: S75-89.
35. Maizels R, Yazdanbakhsh M. Immune regulation by helminth parasites: cellular and molecular mechanisms. Nat Rev Immunol 2003; 3(9): 733-44.
36. Avazpoor M, Yousefipoor M, Dusty M, Mehdipour M, Seifipour F, Gholami Z. Determination of the level of parasitic infection (Cryptosporidium and Giardia) of the vegetables marketed in Ilam city. Environmental Health Engineering and Management Journal 2015; 2(1): 37-40.
37. Sajjadi P, Seddighian F, Alaeddoleie H. The prevalence of intestinal parasitic infection among high school girls in Babol (1996). J Babol Univ Med Sci 2000; 2(1): 39-43. [In Persian].
38. Ghorbannia Delavar A, Nahrevanian H, Assmar M, Amirkhany A, Esfandiary B. Frequency of cryptosporidiosis, isosporiasis and other enteropathogenic parasites in gastroenteritic patients (Babol and Babolsar; 2005-2006). JBUMS 2008; 10(2): 56-61. [In Persian].
39. Abedian S, Parsaei MR. The prevalence of parasite infection in eastern areas of Mazandaran. Third congress of Parasitology and Parasite Infection; Iran, Sari; 1999.